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General Notes.

GEOLOGY AND PALEONTOLOGY.

The North American Coal Supply.¹—General Wistar's discussion of the North American Coal Supply has been published by the Phila. Academy. The author first calculates the existing quantity of available coal in North America, the present and prospective rate of its consumption, its probable duration, and some of the physical consequences of its entire combustion. The figures and conclusions of the United States Census returns of 1889 have been followed, modified somewhat by the author's personal observations.

"The entire carboniferous area of the United States, excluding the broken Rocky Mountain territory is given at 219,080 square miles. A large proportion of this area, however, never did contain coal; and there are minor areas where more than two-thirds of the original beds have been carried away along with the adjacent protecting rocks and scattered far out on the sea bottom.

Again, much of the coal possesses no economical value because of its crushed and impaired condition, its detached position in small basins, and to the thinness of many beds. These reductions may be considered to offset the following items not considered in the Census report:

1. The detached basins in the Rocky Mountain territory.
2. The inaccessible coal of the arctic and tropical regions.
3. The relatively small beds of Nova Scotia and British Columbia.

Assuming then, the area, 219,080 square miles, as the area of mineable coal, the author discusses at length the data for calculating the average thickness and arrives at the conclusion that six feet is an admissible working estimate. This gives 219,080 square miles reduced to acres multiplied by 6 feet (of thickness) and by 800, being the available tonnage per foot of thickness from each acre, would give the tonnage, which is 673,013 millions of tons.

The same Census report states the consumption during the year 1889 at 126,097,779 tons, and the increase of consumption to have been at the rate of 100 per cent. per decade. From these figures the

¹Remarks on the Quantity, Rate of Consumption, and Probable Duration of North American Coal, and the Consequence to Air-Breathing Animals of its entire Combustion. *Proceeds. Phila. Acad.*, 1892, p. 83.

author calculates that the entire coal supply will be consumed at the end of 112 years from the year reported on, or say by A. D. 2001.

This is a fair deduction from facts which are known, and from reasonable estimates, the author calls attention to the importance of looking for some "power" or "force" to take the place of that generated by the combustion of coal when that supply shall be exhausted, as it undoubtedly will in little more than three generations. He maintains there is no intelligent ground for the expectation of the discovery of any new force, but suggests that physicists study more effective and cheaper methods of obtaining electrical energy.

The latter part of the paper is devoted to interesting speculations as to the effect of the increased amount of carbon dioxide in the atmosphere, resulting from the combustion of so much carbon, upon animal and vegetable life.

Cretacic Marine Currents in France.—At a recent meeting of the Académie des Sciences de Paris, M. Fouqué presented a note from M. Munier-Chalmas on the distribution and the direction of the marine currents in France during the upper Cretacic period. He shows the influence of the Alps upon the limitation to the South of that mountain system of certain molluscs and echinoids peculiar to southern regions, and gives an interesting picture of the vanishing from North to South, through the narrow Paris basin, of certain fossils peculiar to the northern seas: *Micrasters*, *Belemnites*, *Rhynchonellas*, etc.

This fact is analogous to what is now going on in the neighborhood of the Straits of Gibraltar. (*Revue Scientifique*, 9 April, 1892.)

Professor Marsh on Extinct Horses and Other Mammalia.¹—In the *American Journal of Science and Arts* for April and May, 1892, appear two articles by Professor Marsh on the above subjects. As they are rather more than usually curious contributions to literature, they deserve early notice. The first cited is stated in the title to be "On Recent Polydactyle Horses," but it turns out to include a discussion of the extinct ancestors of the horse. This is preceded by descriptions of some remarkable examples of horses with supernumerary digits, one of which has rudiments of four in the anterior foot, a number unprecedented in the annals of polydactylism. The author then gives figures of the feet of the extinct horses, to

¹On Recent Polydactyle Horses, *Amer. Journ. Sci. Arts*, 1892 April, p. 339.—A New Order of Extinct Eocene Mammalia, *Amer. Journ. Sci. Arts*, May, 1892, p. 445.

which he has applied the names *Orohippus*, *Mesohippus* and *Miohippus*, and shows what has been already suspected, that they do not differ from those described and figured many years previously as *Hyracotherium* for the first named, and *Anchitherium* for the second and third. He laments the tendency of naturalists to adhere to the appropriate names given by Professor Owen many years ago to the suborders *Perissodactyla* and *Artiodactyla*, and their failure to adopt his own names given to the same divisions, most unnecessarily, many years later. He then repeats as original some generalizations as to the origin of the line of the *Perissodactyla*, including the horses, which had been long previously made by others, and repeats a new name given to the extinct order *Condylarthra*, which was intended by him to express an anticipation of its future discovery. Unfortunately this prophecy had been made by others in 1873, and the discovery of the order had been already made and published (1881) before this prophecy of Professor Marsh's was uttered and the speculative name given (1885). He then goes on to state that the genus which first demonstrated the character of this ancestral type as foretold by Cope (1873), which is known as *Phenacodus*, is the American representative of *Hyracotherium*, and was previously named by him *Helohyus*. Professor Marsh evidently greatly mistakes the characters of *Phenacodus*, as that genus belongs to a distinct family and order from *Hyracotherium*. In spite of this assumption as to the ancestry of the horses, Professor Marsh contributes further to the confusion of his writings, by proposing a new name (*Hippops*) for the speculative ancestral horse. On the strength of his discovery (?) as to the true position of *Helohyus*, he proposes for it a new family of which it is the type, with a definition which in no way differs from that already given by other authors to the *Hyracotheriine* division of the family *Lophiodontidæ*,¹ and which excludes *Phenacodus* and all other *Condylarthra* from its limits. It is interesting to observe that Professor Marsh did not define the alleged genus *Helohyus* when he proposed it, and it is very curious that he does not do so now. He next defines for the first time his "*Orohippidæ*"; but the definition does not distinguish whatever it is supposed to embrace, from the before-mentioned "*Helohyidæ*," and we have further confirmation of the prevalent opinion that this name is also superfluous. On the next page definitions of the alleged genera *Eohippus*, *Helohippus*, *Orohippus* and *Epihippus*, are given for the first time, *i. e.* sixteen years after the names were proposed (except *Helohippus*, which is new). The names

¹AMERICAN NATURALIST, 1887, 993. *Perissodactyla*.

should therefore bear date, 1892. The author shows that *Eohippus* is not as primitive a type as *Systemodon*, and that it is little, if at all, distinct from *Hyracotherium*. *Helohippus* he does not distinguish from *Pliolophus* Owen (1841). "*Orohippus*" is not distinguished from "*Epihippus*." He then fails to distinguish "*Miohippus*" from the long known *Anchitherium*, and correctly describes the characters of *Protohippus* as though he had discovered them, although they were made known by others seventeen years ago.

The article in the May number of the *American Journal* recites that Professor Marsh has "discovered" a new order of Ungulata which he calls the "*Mesodactyla*," which is established on a new genus which he terms "*Hyracops*." This genus is defined with the omission of essential details as to the structures of the upper and lower molars. It is said to resemble *Meniscotherium*, differing only in that the last premolars resemble the true molars. This definition is of very doubtful value, since in *Meniscotherium* the last inferior true molar is like a true molar, and the last deciduous superior molar, has the same peculiarity, and persists, as Marsh observes, a long time.¹ Professor Marsh gives us figures of the fore and hind feet of his specimen, which are very welcome, as the structure of the former has been hitherto unknown. These figures show that the reference of *Meniscotherium* to the order *Condylarthra* made in 1885 is correct. As to the name *Mesodactyla*, it will probably be adopted when the universally adopted *Artiodactyla* and *Perissodactyla* are put aside for the names Professor Marsh so strangely desires us to use in their place. The proposal of a new name is all the more remarkable since Professor Marsh had already proposed a new name (as recited in the first article here commented on) for the theoretical type which is actually represented in this foot structure, as anticipated by Cope in 1873, and actually discovered in 1881.² In his discussion of the affinities of this form, Marsh repeats well-known generalizations as new and especially one made by myself, which has not found general acceptance, viz: that this type (the *Condylarthra*) is ancestral to the Lemurine *Quadrumanus*. This generalization is fully confirmed.—E. D. COPE.

On the Correlation of Moraines with Raised Beaches of Lake Erie.—During the field seasons of 1889, 1890 and 1891, Mr. Frank Leverett made a series of observations of the raised beaches

¹Such a specimen is represented by Cope in the Tertiary Mammalia. Pl. xxvi, fig. 2, 1885.

²AMERICAN NATURALIST, 1881, p. 1017.

of Lake Erie, which are embodied in a paper published in the *American Journal of Science*, April, 1892. The results of the author's studies are summarized as follows:

"It appears that Lake Erie, in its earlier stages, was but a small body of water, its size being conditional by the position of the retreating ice-sheet and by the height of the Western rim of the basin it occupied. It at first occupied only a portion of the district between the outlet and the Western end of the present lake, the remainder of the basin, including the whole of the area of the present lake, being occupied by the ice-sheet. Its South and North shores were then at the Van Wert ridge, while its Eastern border was at the Blanchard moraine.

"By a recession of the ice-sheet Northeastward to about the meridian of Cleveland, the lake became much expanded and its level was lowered a few feet, though the outlet still continued down the Wabash. Its North and South shores then occupied the Leipsic beach, while on the East the wave still beat against the ice front. The ice-sheet itself seems to have broken into bergs at its margin, and to have formed no terminal moraine at that time, though its lateral moraine is well developed.

"A subsequent recession resulted in the lowering of the lake below the level of the Ft. Wayne outlet, probably by opening a passage to the Chicago outlet, for no other outlets were open to this lake at that time through the Huron and Michigan basins. The North and South shores of the lake were then occupying the Belmore beach, while the East shore was unrecorded because the waves beat against a vanishing sheet of ice, and the ice itself, as in the preceding stage seems to have failed to form a terminal moraine, though its lateral moraine is strong.

"From the phenomena attending the replacement of the three beaches in Ohio by moraines, we are led to suspect that two later beaches which die away in Southwestern New York are there connected with moraines, and that similar moraines will be found to connect with the beaches of Lake Ontario, at points where they disappear on its Eastern and Northern borders.

"Differential uplift was slight in the Western Erie basin compared with what it was in the Eastern Erie basin and the Ontario, in Michigan, and on the Canadian shores of Lake Huron and Georgian Bay. The data at hand indicate that it amounts to scarcely more than ten feet in the whole area of the portion of the Erie basin West of Cleve-

land, and has therefore played an insignificant part in causing the three stages of the lake herein described.

"The bulk of the moraines is many times that of the beach deposits, though no longer time was involved in their deposition. The ice-sheet was therefore a much more efficient transporting agency than the lake waves.

"The extreme scarcity of evidence of life in these waters, though negative in its nature, and therefore to be taken with caution, is quite accordant with the theory deduced from the relation of the beaches to the moraines, viz: that the beaches are of glacial age."

Glacial Movements.—Prince Roland Bonaparte has been carrying on some extensive researches on the advance and recession of the glaciers of the French Alps. His work is thus referred to by the *Revue Scientifique*, April 9, 1892.

In order to express in figures the extent of glacial movements, Prince Roland Bonaparte, in 1890, had a certain number of marks put at the foot of sixteen large glaciers of Pelvoux. Whenever it was possible he had made a detailed topographical plan of the front of the glacier which, at the same time, was photographed from a point carefully marked. These operations repeated each year will furnish, and have already furnished precise data as to the oscillations of the glaciers, they will some day, perhaps, show a connection between their movements and the general phenomena of the atmosphere. For the present, the results which he has obtained from sixteen glaciers, from 1 to 6 kilometers in length, show that during 1890 and 1891 several of them have ceased to recede and have become stationary, which indicates the close of a period of general recession which began about 35 years ago. But the period of forward movement in the glaciers of Pelvoux is quite recent, for the facts observed go to show that the first glaciers which have advanced commenced to do so within the last few years.

The exact measures taken by Prince Roland Bonaparte are supplemented by the observations made at his request by the guides of that region in 1891; these extend over twenty-eight other glaciers of Pelvoux and can be summed up as follows: Eight glaciers advancing, twenty glaciers receding, and ten glaciers stationary. Finally, in 1891, the author marked fifteen glaciers in Savoy, and twenty in the Pyrenees. In these two regions the greater part of the glaciers are still receding, but they are increasing at their source, which indicates a speedy change to an advance.

Geology of the Tonga Islands.—In the May number of the *Geological Magazine*, 1891, Mr. Alfred Harker makes the following statements concerning the Tonga Islands in the South Pacific Ocean :

“ It is well known that most of the Pacific islands which have been explored seem to be built largely of either volcanic or calcareous formations, usually supposed to be of recent origin. Indeed, the idea seems to have been entertained in some quarters that such was the universal construction of the islands. Drasche, writing in 1879, restricted this theory to those islands lying eastward of a certain line, drawn from Kamschatka through Japan, the Philippines, New Guinea, New Caledonia, New Zealand, Auckland, and Macquarie Islands to the Antarctic Victoria. Even at that time, however, such rocks as clay-slates, graywackes, etc., had been recorded in the Chatham Islands and New Britain, east of Drasche's line, and leptinites, granite, and gneiss in the Marquesas, far to the East. Later researches have proved the existence of numerous crystalline rocks, igneous and metamorphic, in the larger islands of the Fiji and Solomon Archipelagos, and suggested that in many other islands such rocks may be only masked by a comparatively thin covering of organic or volcanic accumulations.

“ It may be inquired, then, whether the Tonga Islands show any indication of the existence of denuded crystalline rocks beneath the newer deposits. No such rocks have been found in place, and the evidence available is very slight. Ena, the most Southerly of the larger islands, differs to some extent from the rest in geological structure, and from the Eastern shore of this island Mr. Lister collected a boulder, one of many seen there, which is neither a volcanic nor an organic rock. I have described it (*Geol. Mag.*, April, p. 172) as a uralitized gabbro, and, though some petrologists would prefer to name it diabase, it is unlike any superficially erupted lava. Further, there is no doubt that it is derived from the island on which it was found. The only other suggestive point is the rare presence of minute fragments of red garnet and blue tourmaline in the calcareous andesitic sandstones largely developed on the same island. These fragments, blown out from a volcano, point to the existence of metamorphic rocks below, though at what depth it would be idle to speculate.

“ With the exception of Falcon Island rocks, all those examined from the Tonga Island appear to be of submarine formation. The absence or presence in different strata of any sensible proportion of calcareous matter and organic remains is perhaps related to the more or less rapid rate of accumulation at different epochs of eruption. The volcanic material ejected seems to have been almost exclusively of frag-

mental character, and in some cases there are indications of violent explosive action. This is quite in accord with the andesitic nature of materials thrown out, which are of types common in the Pacific region. As to the age of the rocks, it would be idle to speak until the evidence of their organic contents has been duly set forth; but it would undoubtedly be very rash to refer them all to a recent age, and some of them may be found to go back far into the Tertiary times."

Geological News—General.—Several fossils collected by M. Griesbach while exploring the Central Himalayas closely resemble those found in the corresponding Alpine beds. In view of this fact, the Academy of Sciences of Vienna has decided, by an agreement with the Indian Government upon an exploration of the Central Himalayan region in order to compare its geology with that of the Eastern Alps. M. Diener, president of the Alpine Club of Vienna, will take charge of the expedition. (*Revue Scientifique*, April, 1892.)

MINERALOGY AND PETROGRAPHY.¹

Petrographical News.—One of the most valuable contributions to American petrography that has yet appeared is that volume of the Arkansas Geological Survey Report that treats of the eruptive rocks of the State. In it the late Dr. J. F. Williams² gives an excellent account of the little-known but very interesting eleolite and leucite rocks that occur as bosses and dykes in Pulaski, Saline, Hotsprings, Garland and Montgomery Counties. It would be well worth the while to give a full abstract of the author's careful investigation of these extremely rare rock-types, but space allows merely a reference to the mere outline of his work. Especial importance is attached to the study of the eleolite syenites at the present time, particularly where its plutonic and dyke forms occur together, since Rosenbusch has recently prophesied the existence of a group of dyke forms which he calls monchiquites, that will be found to occupy a position among the eleolite rocks corresponding to that held by the camptonites, among the plagioclase rocks. The age of the Arkansas eruptives is probably late Cretaceous. In Pulaski County they form the main mass of Fourche Mountain. The most abundant variety here is that locally known as 'blue granite.' It is a granitic porphyritic rock in which the

¹Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

²Ann. Rep. Geol. Surv. of Ark. for 1890, vol. ii, 457 pp.